

WHAT IS CLAIMED IS:

1. A spectrometer, comprising:
 - a substrate;
 - a first spectrometer secured relative to the substrate, the first spectrometer comprising a first tunable optical filter and a first detector, the first tunable optical filter and the first detector adapted to detect a first tunable range of wavelengths; and
 - a second spectrometer secured relative to the substrate, the second spectrometer comprising a second tunable optical filter and a second detector, the second tunable optical filter and the second detector adapted to detect a second tunable range of wavelengths.
2. A spectrometer according to claim 1 wherein the first spectrometer is a UV light spectrometer that includes a tunable UV bandpass filter and a UV sensitive detector positioned in proximity to the UV bandpass filter.
3. A spectrometer according to claim 1 wherein the second spectrometer is a visible light spectrometer that includes a tunable visible bandpass filter and a visible light sensitive detector positioned in proximity to the visible bandpass filter.
4. A spectrometer according to claim 2 wherein the second spectrometer is a visible light spectrometer that includes a tunable visible bandpass filter and a visible light sensitive detector positioned in proximity to the visible bandpass filter.

5. A spectrometer according to claim 1 wherein the substrate includes read out electronics that are electrically coupled to the first detector and the second detector.

6. A spectrometer according to claim 1 wherein the first spectrometer is positioned adjacent the second spectrometer to receive different parts of a common light beam.

7. A spectrometer according to claim 2, wherein the tunable UV bandpass filter comprises a Fabry-Perot filter configured to pass a selectable range of wavelengths of light, the selectable range of wavelengths of light falling within a range of about 4 to about 400 nanometers.

8. A spectrometer according to claim 7, wherein the selectable range of wavelengths falls within a range of about 300 to about 360 nanometers.

9. A spectrometer according to claim 3, wherein the visible light bandpass filter comprises a Fabry-Perot filter configured to pass a selectable range of wavelengths of light, the selectable range of wavelengths of light falling within a range of about 400 to about 800 nanometers.

10. A spectrometer according to claim 9, wherein the selectable range of wavelengths falls within a range of about 400 to about 500 nanometers.

11. A spectrometer according to claim 4, wherein the UV sensitive detector is relatively insensitive to visible light.

12. A spectrometer according to claim 11, wherein the UV sensitive detector comprises an AlGaIn detector located adjacent to the substrate.

13. A spectrometer according to claim 4, wherein the visible light sensitive detector comprises a photodiode formed within or on the substrate.

14. A spectrometer according to claim 4, wherein the UV tunable bandpass filter is positioned above the UV sensitive detector.

15. A spectrometer according to claim 4, wherein the visible light bandpass filter is positioned above the visible light sensitive detector.

16. A spectrometer according to claim 1, further comprising a plurality of first spectrometers and a plurality of second spectrometers arranged in an array.

17. A spectrometer according to claim 11, wherein the plurality of first spectrometers are arranged in a first linear array and the plurality of second spectrometers are arranged in a second linear array positioned adjacent the first linear array.

18. A spectrometer according to claim 17, wherein at least one of the plurality of first spectrometers and at least one of the plurality of second spectrometers are paired in the array.

19. A spectrometer, comprising:

a UV bandpass filter configured to selectively pass at least a range of ultraviolet light, the UV bandpass filter comprising a first plate and a second plate that are separated by a first separation gap, where the UV bandpass filter is selectively tunable by adjusting the first separation gap;

a UV light sensitive detector positioned downstream of the UV bandpass filter to receive light passed by the UV bandpass filter;

a visible bandpass filter configured to selectively pass at least a range of visible light, the visible bandpass filter comprising a third plate and a fourth plate that are separated by a second separation gap, where the visible bandpass filter is selectively tunable by adjusting the second separation gap; and

a visible light sensitive detector positioned downstream of the visible bandpass filter to receive light passed by the visible bandpass filter.

20. A spectrometer according to claim 19, wherein the first plate is at least partially reflective and comprises a $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric mirror stack.

21. A spectrometer according to claim 19, wherein the second plate is at least partially reflective and comprises a $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric mirror stack.

22. A spectrometer according to claim 19, wherein the UV bandpass filter is tunable to bandpass wavelengths that fall within the range of about 300 nanometers to about 360 nanometers.

23. A spectrometer according to claim 19, wherein the UV light sensitive detector comprises an AlGaIn detector.

24. A spectrometer according to claim 19, further comprising an amplifier in communication with the UV light sensitive detector.

25. A spectrometer according to claim 19, wherein the third plate is at least partially reflective and comprises a $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric mirror stack.

26. A spectrometer according to claim 19, wherein the fourth plate is at least partially reflective and comprises a $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric mirror stack.

27. A spectrometer according to claim 19, wherein the visible light bandpass filter is tunable to bandpass wavelengths that fall within the range of about 400 nanometers to about 500 nanometers.

28. A spectrometer according to claim 19, wherein the UV bandpass filter, the UV light sensitive detector, the visible bandpass filter, and the visible light sensitive detector are secured to a common substrate.

29. A multiple wavelength spectrometer, comprising:

a plurality of first bandpass filters each configured to selectively pass at least a first range of wavelengths, each of the first bandpass filters comprising an upper plate and a lower plate that are separated by a first separation gap, where the first bandpass filters are selectively tunable by adjusting the first separation gap;

a plurality of first light detectors positioned downstream of the plurality of first bandpass filters to receive light passed by the first bandpass filters;

a plurality of second bandpass filters each configured to selectively pass at least a second range of wavelengths, wherein the first range of wavelengths is different from the second range of wavelengths, each of the second bandpass filters comprising an upper plate and a lower plate that are separated by a second separation gap, where the second bandpass filters are selectively tunable by adjusting the second separation gap; and

a plurality of second light detectors positioned downstream of the plurality of second bandpass filters to receive light passed by the second bandpass filters.

30. A multiple wavelength spectrometer according to claim 29, wherein at least some of the plurality of first bandpass filters are configured to selectively pass a common subset of wavelengths within the first range of wavelengths.

31. A multiple wavelength spectrometer according to claim 29, wherein at least some of the plurality of first bandpass filters are configured to selectively pass a different subset of wavelengths within the first range of wavelengths.

32. A multiple wavelength spectrometer according to claim 29, wherein at least some of the plurality of second bandpass filters are configured to selectively pass a common subset of wavelengths within the second range of wavelengths.

33. A multiple wavelength spectrometer according to claim 29, wherein at least some of the plurality of second bandpass filters are configured to selectively pass a different subset of wavelengths within the second range of wavelengths.

34. A multiple wavelength spectrometer according to claim 29, wherein at least some of the upper plates and at least some of the lower plates of the first bandpass filters are at least partially reflective and comprise $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric mirror stacks.

35. A multiple wavelength spectrometer according to claim 29, wherein at least some of the upper plates and at least some of the lower plates of the second bandpass filters are at least partially reflective and comprise $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric mirror stacks.

36. A method of detecting biological materials within a sample, comprising steps of:

subjecting the sample to an energy source to induce fluorescence in at least some of the biological material within the sample; and

simultaneously measuring at least some of the induced fluorescence using a UV light spectrometer and a visible light spectrometer.

37. A method of forming a bandpass filter comprising a UV bandpass filter and a visible light bandpass filter, the method comprising steps of:

providing a substrate having at least a first portion and an adjacent second portion;

forming a first multilayer dielectric plate adapted for ultraviolet light on the first portion of the substrate;

forming a first multilayer dielectric plate adapted for visible light on the second portion of the substrate;

forming a second multilayer dielectric plate adapted for ultraviolet light, vertically aligned with the first ultraviolet light-adapted multilayer dielectric plate; and

forming a second multilayer dielectric plate adapted for visible light, vertically aligned with the first visible light-adapted multilayer dielectric plate;

wherein there is an ultraviolet separation gap between the first and second ultraviolet light-adapted multilayer dielectric plates and a visible light separation gap between the first and second visible light-adapted multilayer dielectric plates.

38. A method according to claim 37 further comprising the steps of providing one or more sacrificial layers over the first multilayer dielectric plate adapted for ultraviolet light, and forming the second multilayer dielectric plate adapted for ultraviolet light over the one or more sacrificial layers.

39. A method according to claim 37 further comprising the steps of providing one or more sacrificial layers over the first multilayer dielectric plate adapted for visible light, and forming the second multilayer dielectric plate adapted for visible light over the one or more sacrificial layers.

40. A method of forming a bandpass filter comprising a UV bandpass filter and a visible light bandpass filter, the method comprising steps of:

providing a substrate having at least a first portion and an adjacent second portion;

forming a first $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plate over the first portion of the substrate;

forming a first $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plate over the second portion of the substrate;

providing a sacrificial layer over the $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plate and the $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plate, the sacrificial layer having a first thickness over the $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plate and a second thickness over the $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plate;

forming a second $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plate over the sacrificial layer, which is vertically aligned with the first $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plate;

forming a second $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plate over the sacrificial layer, which is vertically aligned with the first $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plate; and

removing at least a portion of the sacrificial layer to provide a ultraviolet separation gap between the first and second $\text{ZrO}_2/\text{SiO}_2$ multilayer dielectric plates and a visible light separation gap between the first and second $\text{TiO}_2/\text{SiO}_2$ multilayer dielectric plates.

41. A method of forming a bandpass filter array, comprising steps of:

providing a substrate;

forming a first plurality of multilayer dielectric plates adapted for ultraviolet light over the substrate, each of the first plurality of multilayer dielectric plates that are adapted for ultraviolet light are spaced apart by a distance;

forming a first plurality of multilayer dielectric plates adapted for visible light over the substrate, each of the first plurality of multilayer dielectric plates that are adapted for visible light are positioned in between adjacent multilayer dielectric plates adapted for ultraviolet light;

providing a sacrificial layer over the first multilayer dielectric plates, the sacrificial layer having a first thickness over the plurality of multilayer dielectric plates adapted for ultraviolet light and a second thickness over the plurality of multilayer dielectric plates adapted for visible light;

forming a second plurality of multilayer dielectric plates adapted for ultraviolet light over the sacrificial layer, each vertically aligned with a corresponding one of the first ultraviolet light-adapted multilayer dielectric plates;

forming a second plurality of multilayer dielectric plates adapted for visible light over the sacrificial layer, each vertically aligned with a corresponding one of the first visible light-adapted multilayer dielectric plates; and

removing at least a portion of the sacrificial layer to provide a plurality of ultraviolet separation gaps between each of the first and second ultraviolet light-adapted multilayer dielectric plates and a plurality of visible light separation gaps between each of the first and second visible light-adapted multilayer dielectric plates.

42. A spectrometer for detecting a first wavelength of light and a second wavelength of light, comprising:

a first spectrometer including a first detector downstream of a first optical filter, the first detector being sensitive to the first wavelength of light but not substantially sensitive to the second wavelength of light; and

a second spectrometer including a second detector downstream of a second optical filter, the second optical filter substantially absorbing the first wavelength of the light.

43. A spectrometer according to claim 42 wherein the first wavelength of light is in the UV band.

44. A spectrometer according to claim 43 wherein the second wavelength of light is in the visible band.

45. A spectrometer according to claim 44 wherein the first detector is an AlGaIn detector.

46. A spectrometer according to claim 45 wherein the second detector is a silicon based detector.

47. A spectrometer according to claim 46 wherein the first optical filter includes ZrO_2 .

48. A spectrometer according to claim 47 wherein the second optical filter includes TiO_2 .